LETTERS TO THE EDITOR

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[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Nomenclature in Elasticity

IN reference to a communication of mine which you published not long ago (see NATURE, vol. xxxi. p. 504) on this subject, I have pleasure in enclosing for publication, should you think fit, photos from three automatically recorded stress-and-strain diagrams made in my laboratory. The originals were traced on smoked glass, the glass plate then varnished to fix it, and used at once as a negative. Test-piece No. 9461, of which Fig. 1 shows the behaviour, was a very ductile piece of Swedish bar-iron, turned to ¾-inch diameter. The extensions were measured

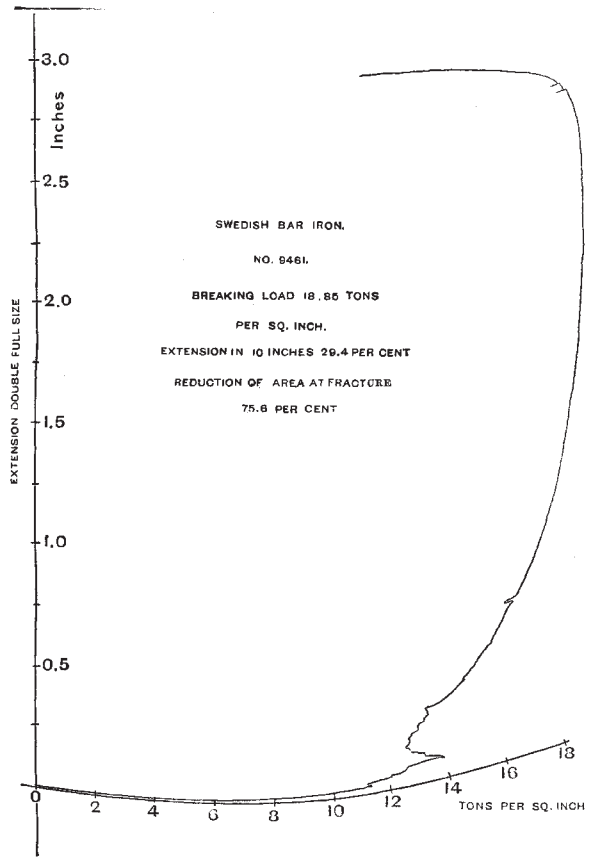


FIG. 1.

on a length of 10 inches, and recorded *double* full size; they are to be measured from the curved base-line, distances along which measure the total load on the piece (on a scale, as recorded, of about 1·9 tons per inch), and therefore the load per unit area (or, as I prefer to call it, the *intensity of stress*) up to the limit of elasticity, to which point the cross-section remains practically unchanged. The point where *instability* comes in is very marked, and also the release or going back of the stress after the material has "broken down." Lastly, the condition of local flow, or whatever it is to be called, is excellently shown. The material draws down in one place, so that the increase of extension, being confined to that place, is very small, and the total load diminishes, although the intensity of stress, on the now greatly reduced area, is much increased, as is shown further on in Fig. 4.

Fig. 2 is an autographic diagram similar to the last, taken from a piece of soft steel (No. 8397) 0·60 inch diameter and 10 inches long. It shows most of the same characteristics, except that the breaking down is not preceded by any intermediate stage; the loss of elasticity comes very suddenly. The whole load was taken off the piece and then reapplied a number of times during the experiment, after the limit was passed, and the curves show most distinctly by their parallelism the (practical) constancy of the modulus of elasticity even up to the very maximum load. The curves show also the curious phenomenon —which I have often noticed in this form, and which, in some of its aspects, has been most carefully examined by Bauschinger and others—of increase of load borne, for a very limited time, after the material has been allowed a short rest—here only a few seconds. If the rest be for hours or days a similar thing occurs in a much more marked fashion.

Fig. 3 is a similar diagram from a piece of "S. C. Crown" iron, showing the same features, although in a less marked degree. In this case the load was removed and reapplied after the piece had begun to draw down visibly, and the curve to turn back, with the result of showing the piece to be still elastic up to the load it had just borne.

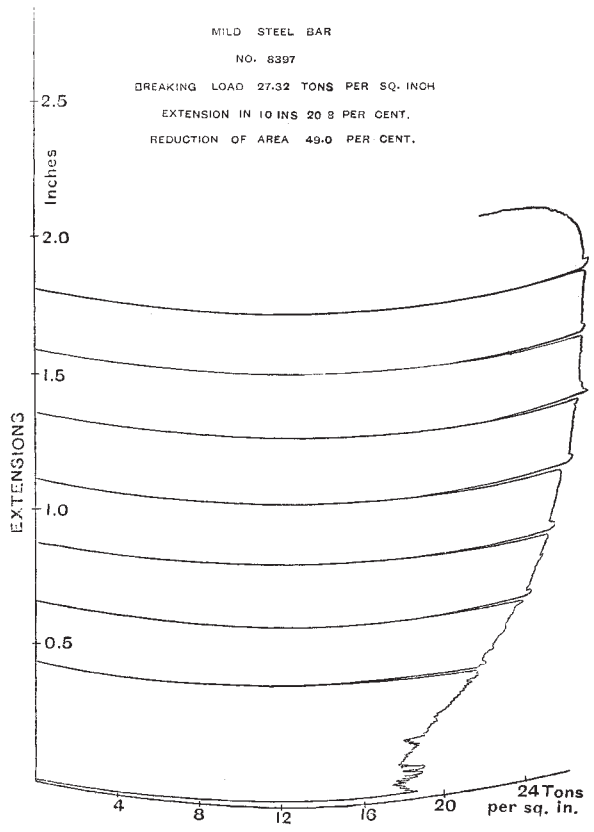


FIG. 2.

Fig. 4, which is a copy of a diagram obtained by consecutive measurements, not automatically, illustrates a question asked, I think, by Mr. Ibbetson. The diameter of the bar under test was measured each time the extension was noted, and the curve of actual stress on actual area (II.) is plotted out, as well as the usual load and strain curve (I.). The most interesting point about it is perhaps the way in which the curve ends nearly parallel to the axis, an excessively small additional extension corresponding to a very great additional intensity of stress. This arises, of course, from the fact that the extension is here confined to a very small length of the bar, the diameter and length of the main part of the bar remaining practically unaltered. If the extensions were plotted to stresses in this main part of the bar, the curve would take the shape (III.).

All these curves illustrate distinctly, I think, a point not very generally known, that the non-elastic extensions form really a

curve passing through the zero point of stress and strain, just as do the elastic ones. It appears as if the *non-elastic*, the flowing or plastic state, were the *real* state of the material, the *elastic* condition being something consequent on the treatment which

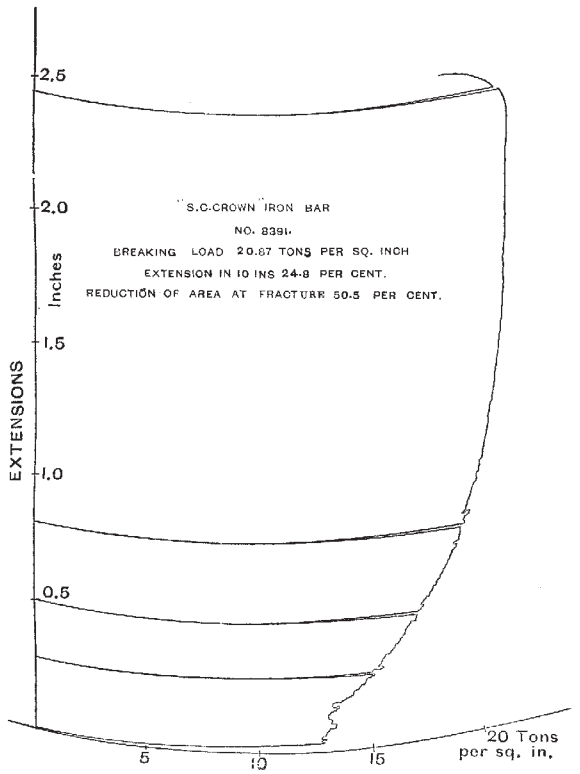


FIG. 3.

the material had undergone. I am bound to say, however, that I have no distinct evidence connecting the ratio $\frac{\text{limit of elasticity}}{\text{maximum load}}$ with the amount of previous work done on a material in manufacture.

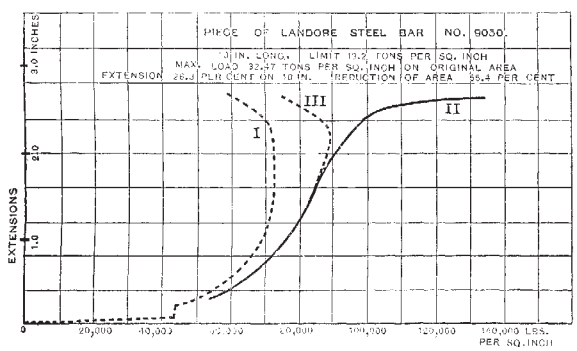


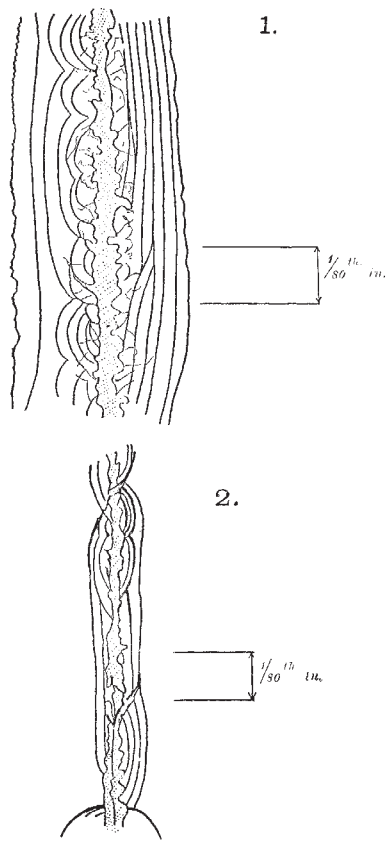
FIG. 4.

I should like to add that the credit of scheming and working out the very ingenious apparatus by which the autographic diagrams figured above were recorded belongs almost entirely to my friend Mr. A. G. Ashcroft, who has been working at the matter for me for some time. ALEX. B. W. KENNEDY

Spectra Produced in Glass by Scratching

A FEW weeks ago, while examining under the microscope a piece of glass on which a coarse scratch had been made by a file, in order to serve as a focussing mark in the determination of refractive index, I noticed a number of narrow, somewhat faintly coloured spectra running along both sides of the scratch. As I can find no account of such an appearance, and an examination of it seemed to throw a little light on the effects of a combined tangential stress and pressure on a brittle medium such as glass, I thought a short description of the phenomena might be interesting to the readers of NATURE.

The spectra (Figs. 1 and 2) run for the most part approximately parallel to the scratch, but those near the scratch are very much curved, the concavity being inwards, and often appear to commence and terminate at irregularities in the scratch. If the glass be left to itself after scratching, the spectra sometimes remain stationary, but not unfrequently spread outwards from the scratch; this process I have watched in three instances. In any case, sooner or later, the glass splits internally along the edge of the outermost spectrum, and sometimes along the others also. I was fortunate enough to watch this splitting in one instance: immediately before it took place the glass gave signs of great activity, the spectra waving about in the field of



FIGS. 1 and 2.—The shaded part in all the figures represents the scratch.

view about three times in as many seconds, oscillating between two extreme positions (*a* and *b* in Fig. 3), and finally coming to rest in the position *b*, while the split developed with great rapidity from above downwards in the field of view. After this splitting has taken place, the spreading of the spectra ceases, and they generally, though not invariably, remain apparently unaltered. The time which elapses between the infliction of the scratch and the development of the split varies from a few minutes to several days or weeks.

The appearance is not shown by all scratches, but only by such as have produced considerable disturbance in the glass: thus they must be fairly deep and must produce some slight amount of splintering.

Next, as to the explanation of the phenomenon. Diffraction from the scratch is negatived by the great distance from the scratch to the spectra, and still more by the fact that they are farther apart the greater their distance from the slit; this important point was determined by careful measurement with a micrometer, using sodium light. They are clearly not due to